003 Report (Group Work)

Module Name:	CPT208 Human-Centric Computing
Group ID and topic:	Group B4 Education and Entertainment – Ancient Fragments
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Introduction

Edutainment, a fusion of education and entertainment, combines educational content with engaging elements to create enjoyable and accessible learning experiences. This approach is implemented through various forms, including games, interactive exhibits, and multimedia presentations, in diverse settings such as classrooms, museums, and online platforms. Edutainment fosters a dynamic learning environment that promotes exploration, creativity, and knowledge retention.

Five cases were selected for a case study on this topic. **Genshin Impact - Wondrous Shadows**, **Monument Valley**, and **A Fisherman's Tale** are three games based on light, shadow, and visual dislocation. The study focuses on their decryption level design, difficulty, and immersive aspects; **Bai Ci Zhan** and **Scallop** are two English word memory software applications. The research examines their immersion in learning and interaction methods. Heuristic learning observation methods include "Think-aloud", feedback, and emotional evaluation. Emotional assessment is based on Hanjalic's Valence-Arousal space theory (Gotsman et al., 2021), which categorizes emotions into two dimensions: higher valence and arousal indicate positive emotions, while lower levels signify negative emotions.

According to Nielsen (1994) that on average five evaluators identify 75-80 percent of usability problems. Therefore, an additional (anonymous) evaluator is invited to participate in the study of each case.

Case 1 Genshin Impact – Wondrous Shadows

Led by	Yang Gu
Participants	Haojun Shen, Yiming Li, Hongbin Zhang, Xiang Xie, Anonymous participant

1. First Walkthrough: Case Introduction and Observation

In the first walkthrough (cognitive walkthrough), evaluators are required to freely use the product for 30 minutes so that they can identify elements to analyze.

"Wondrous Shadows" is an in-game event coinciding with the real-world New Year and Chinese New Year of 2022. Accessible on multiple platforms (PC, tablets, and PS4), Genshin Impact is suitable for ages 12+, excluding those with mental disorders. The event employs light-and-shadow visual dislocation and projection techniques, featuring puzzles with varying Shadow Lantern models. Players must correctly align the perspective to match a predetermined object, combining entertainment with cognitive stimulation.

2. Second Walkthrough: Heuristic Evaluations

In the second walkthrough, evaluators are required to use the product at least for 1 hour in order to scrutinize individual elements according to the heuristics, especially to identify design violations in the game's decryption level design and propose solutions.

2.1. Prevent Errors (Shneiderman, 1992): Clearer feedback is needed when users mistakenly rotate the Shadow Lantern. Solutions include providing a more noticeable warning message upon errors.

2.2. Reduce Short-term Memory Load (Shneiderman, 1992): Although the overall gaming instructions are easy to learn, there are sometimes additional requirements that need the players to focus on; However, the current interface still needs a click on the question mark icon to get the additional instructions which invisibly adds the users' memory load. Solutions include displaying a concise, one-sentence description on-screen.

2.3. User Control and Freedom (Nielsen, 1994): Sometimes it may happen that the users mistakenly rotate the Shadow Lantern into a perspective that reduces the completeness, which is unwanted. However, it seems to be no 'undo' button using which the

users could be back to the previous state which increases the gaming difficulty. Solutions include displaying a concise, one-sentence description on-screen.

2.4. Error Prevention (Nielsen, 1994): If a user clicks the exit button by mistake, the program will directly exit without a confirmation page to the user, and anything previously done in this level would be discarded. Solutions include implementing a confirmation page before exiting.
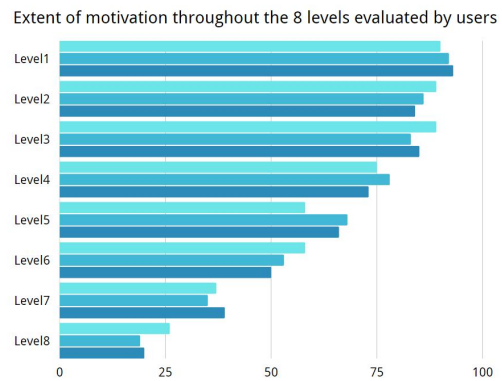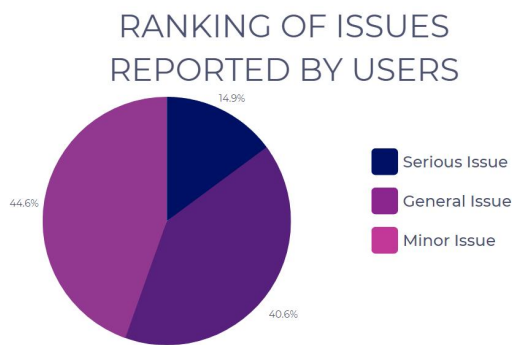
3. Observation of Heuristic Evaluations

Figure 1(a). Ranking of issues reported by users   Figure 1(b). The motivation rankings

The evaluators are invited to try out the game level by level and their responses are recorded in terms of the importance of issues and the extent of motivations that they feel, by the approach of "thinking aloud". The results are shown in Figure 1 above. Figure 1(a) shows the distribution of the issues ranked by the users, with nearly half of them being minor ones, and another considerable amount being general issues. Serious issues only accounted for a little amount. In terms of the motivation rankings as shown in Figure 1(b), the general trend is sliding down as the level index increases, and a significant drop in motivation by users has been found around the final levels.

As stated by Klahr.D. & Nigam.M (2004), a sudden or abrupt increase of difficulty to a great extent of the design of the levels of decryption puzzle games should be avoided. In general, users feel novel about the design of light and shadow decryption in this game. With the improvement of difficulty curve of the game and the enhancement of its immersion, this design is worth learning from more similar products about Education and Entertainment.

Case 2 – **A Fisherman's Tale**

Led by	Hongbin Zhang
Participants	Yang Gu, Haojun Shen, Yiming Li, Xiang Xie, Anonymous participant

1.   First Walkthrough: Case Introduction and Observation

In the first walkthrough (cognitive walkthrough), evaluators are required to freely use the product for 30 minutes so that they can identify elements to analyze.

A Fisherman's Tale is a VR puzzle adventure game suitable for all ages, designed for head-mounted devices like PlayStation VR, HTC Vive, Oculus Rift, and Windows Mixed Reality headsets. Played at home, the game leverages VR for an immersive and interactive experience. The story revolves around a puppet fisherman named Bob in a small lighthouse. Players solve intricate puzzles by manipulating objects and navigating the environment, with unique mechanics like replicating player actions on different scales. Usability and user experience goals include engaging storytelling, intuitive controls, and creative challenges. A Fisherman's Tale addresses balancing immersion and comfort, providing accessibility for varied skill levels, and ensuring compatibility with different VR platforms.

2.   Second Walkthrough: Heuristic Evaluations Result

In the second walkthrough, evaluators are required to use the product at least for 1 hour in order to scrutinize individual elements according to the heuristics, especially to identify design violations in the game's immersive design and propose optimization solutions.

2.1. Consistency and standards (Nielsen, 1994): The game has inconsistencies in its controls, interactions, or visual language, it may lead to confusion and a less user-friendly experience. Solutions include ensuring consistent interactions, control schemes, and visual language across all levels, objects, and menus.

2.2. User control and freedom (Nielsen, 1994): Users find themselves in situations where they cannot easily undo an action or exit a particular game state, it could result in frustration. Solutions include Implementing a more robust "undo" feature that allows players to easily reverse actions and provide clear exit points for various states.

2.3. Visibility of system status (Nielsen, 1994): Users become disoriented or unsure of their progress because the game does not provide adequate feedback on their actions or the state of the game world. Solutions include offering clear visual and auditory feedback on players' actions, puzzle progress, and changes in the game world.

2.4. Enable frequent users to use shortcuts (Shneiderman, 1992): Experienced players cannot use shortcuts or accelerators to speed up their gameplay, it may limit the game's appeal to a more dedicated audience. Solutions include Introducing advanced control options, such as gesture-based shortcuts, to cater to more experienced players.

3.   Observation of Heuristic Evaluations

Evaluators "think-aloud" during the evaluation, noting issues encountered. One expert said, "The learning curve isn't friendly...I still need to go through cumbersome steps." Evaluators then complete a summary form, rating and describing issues. In addition, Facial expressions are captured and assessed by the EmoFAN-VR (Gotsman et al., 2021).
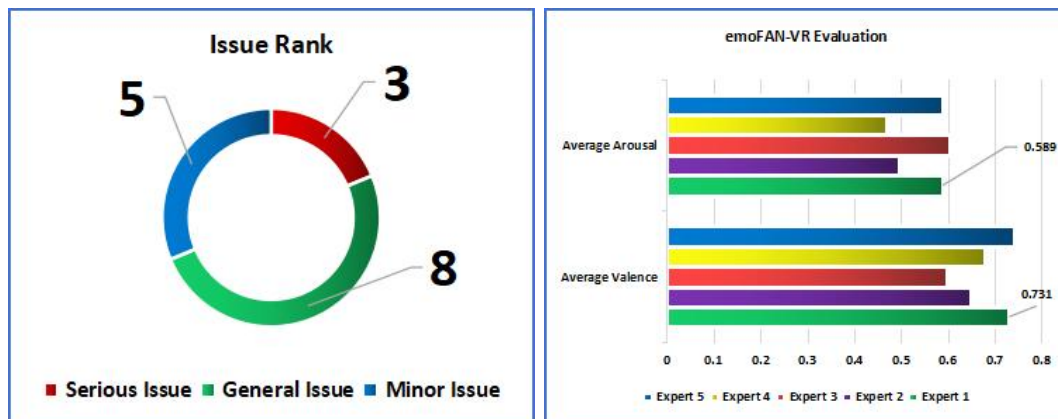

Figure 2(a). Issue rank proportion   Figure 2(b). Model evaluation results

Figure 2(a) displays a smaller number of serious issues compared to ordinary or minor ones, primarily related to gameplay and level design. This can provide some insights for VR products in terms of gameplay and difficulty, such as introducing shortcut gestures to enhance user experience. Figure 2(b) exhibits relatively positive Valence and high Arousal, signifying satisfactory immersive scene construction. In summary, the game was affirmed by the testers in terms of user immersion design, scenario design, and puzzle design, which positively impacts product design in the fields of Education and Entertainment.

Case 3 – Scallop

Led by	Xiang Xie
Participants	Hongbin Zhang, Yang Gu, Haojun Shen, Yiming Li, Anonymous participant

1. First Walkthrough: Case Introduction and Observation

In the first walkthrough (cognitive walkthrough), evaluators are required to freely use the product for 30 minutes so that they can identify elements to analyze.

Scallop is a language learning app available on iOS and Android devices, designed to aid users in memorizing new vocabulary words. The app's features include personalized vocabulary lists, flashcards, quizzes, and progress tracking. Users can interact with the app in various ways, such as sharing vocabulary lists and chatting with other learners to improve language skills. Navigation tools help users move through different lessons and quizzes, while tools for organizing vocabulary lists are also included. Scallop accommodates both beginner and advanced learners, and offers a global platform for language learners to connect and share their experiences.

2. Second Walkthrough: Heuristic Evaluations Result

In the second walkthrough, evaluators are required to use the product at least for 1 hour in order to scrutinize individual elements according to the heuristics, especially to identify potential design violations of the software's interaction design and propose solutions.

2.1. Design dialogs to yield closure (Shneiderman, 1992): Some dialogs in the app do not provide clear closure, leaving the user unsure of what action to take next. Solutions include ensuring that all dialogs provide clear closure and give the user a clear indication of what action to take next.

2.2. Prevent errors (Shneiderman, 1992): The app does not have enough features in place to prevent errors, such as the ability to accidentally delete progress or quizzes. Solutions include implementing more robust error prevention features, such as confirming deletion of progress or quizzes and providing warnings when a user attempts to leave a quiz in progress.

2.3. User control and freedom (Nielsen, 1994): The app does not offer enough customization options or settings to allow the user to have more control over their learning

experience. Solutions include offering more customization options and settings to allow users to tailor their learning experience, such as the ability to adjust difficulty levels or personalize content.

2.4. Permit easy reversal of actions (Shneiderman, 1992): It is difficult for the user to undo or reverse certain actions in the app, which could lead to frustration. Solutions include allowing users to easily undo or reverse certain actions, such as deleting progress or quizzes, or provide an "undo" feature.

3. Observation:

During the heuristic evaluation process, evaluators are asked to use the app for a period, take note of any issues they encounter, and then provide a summary of their observations. During the evaluation of the Scallop app, one evaluator reported experiencing boredom and fatigue due to the repetitive nature of the memory exercises.

Additionally, the evaluators' facial expressions were recorded in real-time and analyzed using the EmoFAN-VR neural network model (Gotsman et al., 2021).
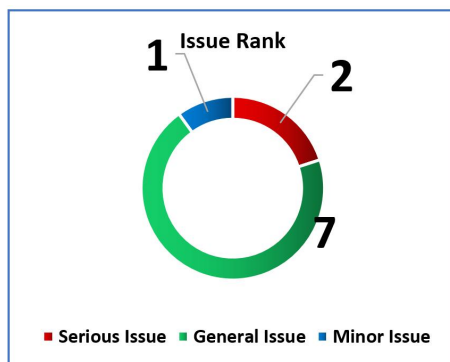

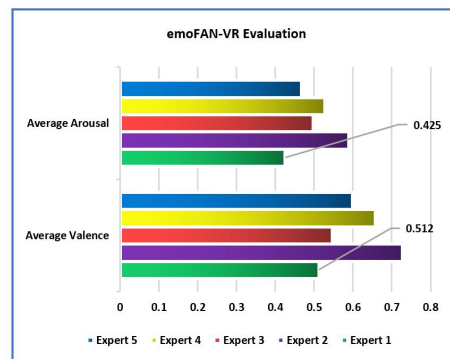Figure 3(a). Issue rank proportion   Figure 3(b). Model evaluation results

According to Figure 3 (a), The number of general issues is much smaller than that of serious and minor issues. The main problem is the lack of playability value, which leads to tiredness. Moreover, the average Valence of evaluators during the experience is insufficiently positive, and the average Arousal is relatively high, which indicates that the user is satisfied with the product. In general, incorporating games or social learning activities will contribute to breaking up the monotony of the memory exercises, make the learning process more enjoyable and improve user interaction experience.

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Case 4 – **Bai Ci Zhan**

Led by	Haojun Shen
Participants	Hongbin Zhang, Yang Gu, Xiang Xie, Yiming Li, Anonymous participant

1. First Walkthrough: Case Introduction and Observation

In the first walkthrough (cognitive walkthrough), evaluators are required to freely use the product for 30 minutes so that they can identify elements to analyze. Bai Ci Zhan is a software focused on English vocabulary learning, targeting English learners who need to quickly improve their vocabulary level. Compatible with iOS and Android devices, this software utilizes the Ebbinghaus Forgetting Curve principle to adjust learning plans based on users' memory curves, enhancing memory performance with pictures, pronunciation, and example sentences. Suitable for various settings such as classrooms, families, and individual learning, it enables convenient learning anytime, anywhere.

Usability and user experience goals emphasize engaging and effective English learning experiences. Bai Ci Zhan addresses issues like balancing entertainment and education, providing accessible experiences for varied skill levels, and ensuring compatibility with different platforms.compatibility with different platforms.

2. Second Walkthrough: Heuristic Evaluations

In the second walkthrough, evaluators are required to use the product at least for 1 hour in order to scrutinize individual elements according to the heuristics, especially to identify potential design violations of the software's interaction design and propose solutions.

2.1. Consistency and standards (Nielsen, 1994): Bai Ci Zhan's design lacks consistency across different screens and features, it confuses users. Solutions include ensuring consistent interactions, control schemes, and visual language across all levels, objects, and menus.

2.2. Flexibility and Efficiency (Nielsen, 1994): Bai Ci Zhan does not offer appropriate feature options for users of different levels, and some users may feel frustrated or bored. Solutions include providing learning content at various difficulty levels and offering shortcuts for experienced users to meet different users' needs.

2.3. User control and freedom (Shneiderman, 1992): Bai Ci Zhan does not provide convenient undo options when users make mistakes, and they feel frustrated. Solutions include offering clear undo and redo actions so that users can easily correct their errors.

2.4. Help Users Recognize, Diagnose, and Recover from Errors (Shneiderman, 1992): Bai Ci Zhan does not provide helpful error information or guidance when users encounter issues, they struggle to resolve them. Solutions include providing clear, friendly error messages when errors occur and guiding users on how to solve the problem.

3. Observation:

During the heuristic evaluation, evaluators "think-aloud" while using the software, expressing encountered issues for recording. One expert said, "Its image memory method could indeed improve my impression of words, but it only deepens my impression of images, and I still tend to forget words, especially their spelling." Evaluators then complete a summary form, rating and describing discovered issues. According to Cowan, N. (2019), the proportion of forgotten words can indicate learning effectiveness.
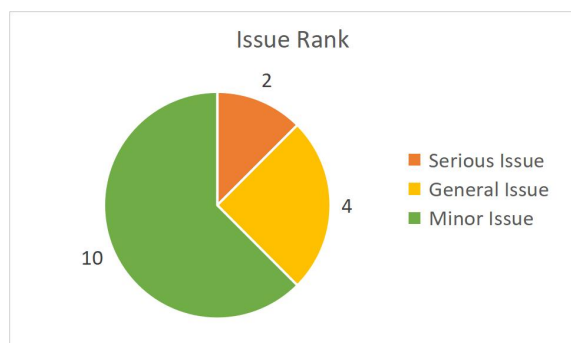

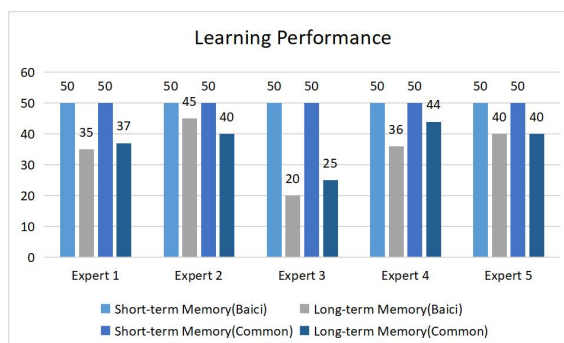Figure 4(a). Issue rank proportion   Figure 4(b). Model evaluation results

Figure 4(a) shows significantly fewer serious issues than minor or ordinary problems, primarily relating to User Interface and Multi-Platform Support. Thus, for edutainment software, the shortcomings in Bai Ci Zhan's user interaction design are worth considering. Additionally, as depicted in Figure 4(b), users' long-term memory performance is lower than other commonly used software. Consequently, the efficiency of learning English vocabulary with Bai Ci Zhan should be scrutinized. The use of image memory is desirable, but may not be suitable for ideographic characters such as English.

Case 5 – **Monument Valley**

Led by	Yiming Li
Participants	Yang Gu, Haojun Shen, Hongbin Zhang, Xiang Xie, Anonymous participant

1. First Walkthrough: Case Introduction and Observation

In the first walkthrough (cognitive walkthrough), evaluators are required to freely use the product for 30 minutes so that they can identify elements to analyze. Monument Valley is a critically acclaimed puzzle game designed for mobile devices, targeted towards individuals who enjoy visually stunning games requiring problem-solving skills and spatial reasoning. Compatible with Android and iOS systems, it uses touch-screen technology for navigation through its levels. The game's context is ideal for on-the-go gaming, with each level completable in a short amount of time. The content and function center around manipulating impossible architecture and optical illusions to progress through each level. The game challenges players to think critically and creatively, enhancing problem-solving skills while providing an immersive and visually stunning gaming experience, which is an excellent example of edutainment in mobile gaming.

2. Second Walkthrough: Heuristic Evaluations Result

In the second walkthrough, evaluators are required to use the product at least for 1 hour in order to scrutinize individual elements according to the heuristics, especially to identify potential design violations of the decryption level design of this game.

2.1. Error prevention (Nielsen, 1994): While Monument Valley offers simple error handling, it lacks a robust error prevention system. The game does not provide warnings or confirmations before players perform irreversible actions. Solutions include providing clear feedback and making common errors more difficult to make.

2.2. Help and documentation (Nielsen, 1994): Although the game's controls are intuitive and easy to learn, it doesn't offer explicit instructions or tutorials for first-time players. Solutions include offering instructions, guidance, and a help section with detailed information.

2.3. Match between system and the real world (Nielsen, 1994): Monument Valley's impossible architecture, part of its unique charm, not always match players' real-world

expectations. Some levels require players to rotate the device in counter-intuitive or uncomfortable ways. Solutions include using familiar and intuitive design patterns to ensure that the game's interface and mechanics match the user's mental model of the real world.

2.4. Reduce short-term memory load (Shneiderman, 1992): Monument Valley requires players to remember complex sequences in some levels, which may frustrate some players. Solutions include simplifying the game's mechanics, providing visual aids and reminders, and using incremental learning to help users remember key information.

3. **Observation of Heuristic Evaluations**

During the heuristic evaluation process, evaluators verbalize their thought process while playing the game, highlighting any issues encountered. Upon completion, evaluators fill out a summary form detailing the issues and rating their severity. One evaluator noted the game presented a significant challenge to their spatial imagination, spending extended periods on certain levels without assistance. Additionally, evaluators' emotional responses are recorded using facial recognition technology and analyzed with the EmoFAN-VR (Gotsman et al., 2021) to identify emotional changes.
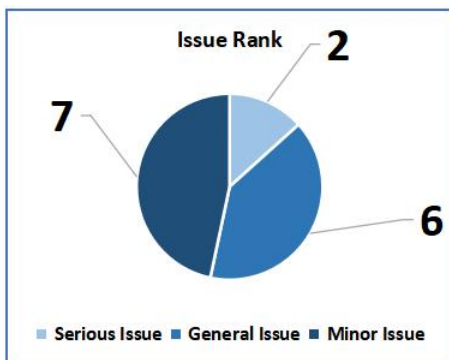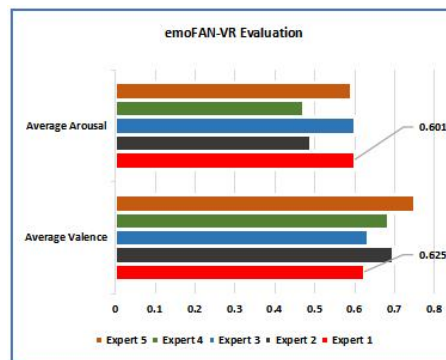

Figure 5(a). Issue rank proportion

Figure 5(b). Model evaluation results

As shown in Figure 5(a), the number of significant issues identified by evaluators is notably lower than that of minor and ordinary problems, with most issues relating to immersive design. Furthermore, from Figure 5(b) we could know that evaluators' average emotional valence is predominantly positive, and the average arousal is relatively high. Overall, when designing game decryption, it is important to consider matching it with the real world, otherwise it may affect the user experience.

Conclusion

Analyzing the five case studies, we conclude that well-designed products greatly impact user engagement and satisfaction. Key factors include immersive gameplay, innovative mechanics, intuitive controls for gaming and VR experiences, and engaging content for language learning apps. Balancing learning and entertainment and continuously evaluating and optimizing usability and user experience are crucial. These case studies offer valuable insights for creating immersive experiences catering to users' needs. Our project benefits from these lessons, the most important conclusion is that using images to memorize ideographic characters is not very effective, but it might not be the case for pictographic characters. This inspires us to explore the idea of learning pictographic characters through VR technology and applying immersive light and shadow puzzle design.

References

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Klahr, D., & Nigam, M. (2004). The equivalence of learning paths in early science instruction: Effects of direct instruction and discovery learning. Psychological Science, 15(10), 661-667.

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Appendix 1. Issue Summary Form

Case Number	Issue Rank	Aspect	Description
1	*Serious Issue*	*Function*	Clearer feedback is needed when users mistakenly rotate the Shadow Lantern.
1	*General Issue*	*Function*	The current interface still needs a click on the question mark icon to get the additional instructions which adds the users' memory load.
		...	
1	*Minor Issue*	*Function*	If a user clicks the exit button by mistake, the program will directly exit without a confirmation page to the user.
2	*General Issue*	*Content*	The game has inconsistencies in its controls,interactions, or visual language.
2	*Serious Issue*	*Function*	Users find themselves in situations where they cannot easily undo an action or exit a particular game state.
		...	
2	*Minor Issue*	*Function*	Users become disoriented or unsure of their progress because the game does not provide adequate feedback on their actions.
3	*Serious Issue*	*Function*	The app does not have enough features in place to prevent errors.
3	*Minor Issue*	*Content*	Some dialogs in the app do not provide clear closure, leaving the user unsure of what action to take next.
		...	
3	*General Issue*	*Function*	The app does not offer enough customization options or settings to allow the user to have more control.

Case Number	Issue Rank	Aspect	Description
4	Serious Issue	Function	Bai Ci Zhan does not provide helpful error information or guidance when users encounter issues, they struggle to resolve them.
4	General Issue	Function	Bai Ci Zhan's design lacks consistency across different screens and features.
...			
4	Minor Issue	Function	Bai Ci Zhan does not offer appropriate feature options for users of different levels, and some users may feel frustrated or bored.
5	Serious Issue	Content	Monument Valley's impossible architecture, part of its unique charm, not always match players' real-world11 expectations
5	General Issue	Function	The game does not provide warnings or confirmations before players perform irreversible actions
...			
5	Minor Issue	Function	Monument Valley requires players to remember complex sequences in some levels, which may frustrate some players.